SE 491-sdmay19-27

Smartphone Tracking App for Microsoft HoloLens

Week 1

08/31/18 - 09/07/08
Client: Optical Operations
Faculty Advisor: Daji Qiao

Team Members:

Ben Holmes - *Android Development*
Anthony House - *Website Development/Security*
Ryan Quigley - *Database Admin*
Jose Lopez - *Website Development*
Travis Harbaugh - *Hololens Development*
Cory Johannes - *Report Management*

Summary:

- Gained an overall understanding of what we should do.
- Built a prototype app that uses phone for tracking
- Discussed potential ways to accomplish what the client wants
- Slack and trello set up
- Got the team member page set up and complete
- Started and finished the team expectations and roles
- Set up times for us to have weekly team meetings
- Set up times to meet with the client
- Got a CentOS server registered

Pending Issues:

- Gitlab integration. We seem to be having connectivity issues.
- Jumping in to seeing how we can use the Android sensors to realize our goal
- What sensors should we use?
- Trial by testing

Individual Contributions:

Team Member	Contribution	Weekly Hours	Total Hours

Ben Holmes	Set up slack Created an Android App for utilizing phone sensors (more info in contributions section)	10	10
Anthony House	Set up trello and linked it to our Slack board so that we will get notifications relating to current work which is either planned for the future, being done now, or has just been finished Entered team info on website (Specifically uploaded all information currently displayed in the team.html page) Organized weekly team meetings	8	8
Ryan Quigley	Helped define groups roles	4	4
Jose Lopez	Updated my bio and added a profile picture on the team website Help create a priority list for the team	3	3
Travis Harbaugh	Refer to bottom	12	12
Cory Johannes	Helped define group roles	4	4

Contributions for Travis Harbaugh:

- Travis Harbaugh-worked on Research, context Diagram
    - Created a context diagram
        - Created a context diagram to show the events and its flows for the scope of our project.
          The context diagram will help to define functional/non-functional requirements for next meeting.
    - Began performing a market analysis.
        - Microsoft made a prototype phone that consists of 3 sensors: accelerometer, compass, and barometric pressure sensors. Their idea was to collect data from these sensors about the users traveled path without GPS. Their idea was to use the accelerometer to calculate the steps taken by the user. They used a barometric sensor to calculate the altitude, so they can detect what floor level they are on.
        - Our client talked about using an Inertial navigation system that the military uses to find their location when merged underwater. The system uses a computer,

motion sensors (accelerometers), gyroscopes, and occasionally magnetic sensors (magnetometers) to continuously calculate by dead reckoning which is the position (2).
        - The accelerometer will have integration drift that will cause error in the calculation of acceleration and angular velocity (2). Once you integrate velocity you will have a larger error and if you integrated it again to get position the error will get bigger. We can use Kalman filtering algorithm to aid with this error
        - The sensors in a phone include proximity sensor, light sensor, Barometer, Magnetometer, Hall Sensor, Accelerometers, and Gyroscope.
        - The proximity sensor is used to detect the presence of nearby object. This sensor uses a beam that is invisible to humans. It works by reflecting an infrared light from a nearby object which is then picked up by a UR detector
        - The barometer will measure the atmospheric pressure that can be used to determine how high the phone is above sea level. The Magnetometer gives an orientation in relation to the Earth's magnetic field.
    - Accelerometers are gravity-based sensors. The gyroscope sensor can provide orientation information with great accuracy. In android this sensor can tell you how much the phone has rotated by and in which direction. This is used by Google Maps to tell what your phone is pointing at..

Contributions for Ben Holmes:

Android application:

- Runs on all smartphones where API >= 21 (This covers over 70% of all current android phone users)
- Implemented the Accelerometer, Magnetometer, Barometer, and Gyroscope sensors
- I also experimented with the following providers, which are used to relay the current Lat/Lng coordinates of the phone:
    - GPS Provider
    - Network Provider
    - Fused Provider
- In the future I plan to implement more of the phone's features including:
    - Microphone
    - Speaker
    - Light Sensor
    - Proximity Sensor

The reasoning behind the current sensor implementations are as follows:

- Barometer
    - Can be used to determine changes in pressure, which generally happen as individuals ascend or descend from sea level. (AKA climbing stairs)

- Gyroscope
    - Used to determine changes in the devices orientation, this can be useful in identifying the phone's orientation, and direction/heading.
    - Ideally, this will be the method of determining a phone's orientation in situations where the Magnetometer readings are unpredictable, or unreliable (Such as when magnets are in the area, or there are other phones disrupting the surrounding magnetic field)
- Magnetometer
    - The Magnetometer reads the magnetic field surrounding the phone.
    - Generally, the Magnetometer will return a vector which points to the North.
    - We can use this to find the phone's orientation in relation to the compass directions.
- Accelerometer
    - Relays acceleration changes (m/s^2) in regards to the phone's coordinate system.
    - These changes in acceleration can be double integrated to find the phone's new position.
    - Essentially this is our main tool in regards to tracking a phone.
- Providers
    - These providers will not be used in predicting the phone's location, but will be useful in comparing our location predictions, to the actual phone's location.

Contributions for Anthony House:

- Please fill out this section

Contributions for Ryan Quigley:

- Please fill out this section

Contributions for Jose Lopez:

- Website
    - Added my bio for the team website

Contributions for Cory Johannes:

- Please fill out this section

Plans for Next Week:

- Travis Harbaugh
    - Experiment with phone's Accelerometer sensors, and research.
- Ben Holmes
    - Start collecting data using the phone's sensors (Need a way to relay phone's sensor output to a computer)

- Ryan Quigley
    - Research, and implementation of transforming accelerometer data into actual displacement relating to earth's compass directions.
    - Also research various methods of tracking a phone, albeit RSSI, accelerometers, sound, or light.
- Cory Johannes
    - Find a map of Durham. (Durham is our testing site)
- Anthony House
    - Api / database set up (API for sending info from the phone to the server)
- Jose Lopez
    - Research the following filters for implementation when collecting data from the phone's sensors.
        - Particle Filter
        - Kalman Filter
        - Low Pass Filter
        - High Pass Filter

References

"Basic Principles of Inertial Navigation Seminar on inertial navigation systems" (PDF). *AeroStudents.com*. Tampere University of Technology, page 5. Retrieved 17 April 2018.

Schwartz, Evan I. “Finding Our Way with Digital Bread Crumbs.” *MIT Technology Review*, MIT Technology Review, 22 Oct. 2012, www.technologyreview.com/s/420277/finding-our-way-with-digital-bread-crumbs/.